Appendix A

Sloan Digital Sky Survey-II
Schedule for the Three-Year Baseline Plan

Introduction

SDSS-II proposes to create three surveys of the sky: complete the spectroscopic footprint of SDSS-I ("Legacy"); Galactic structure in both photometry and in spectroscopy ("SEGUE"); and an imaging survey for Type Ia supernovae ("SN"). This document shows how these surveys fit together, how time is apportioned, and provides benchmarks against which progress can be reckoned. In more detail:

Legacy intends to complete the coverage of the sky in the area defined by stripes 10 through 37, inclusive, in both imaging and spectroscopy. (The system of stripes is defined at http://www.sdss.org/dr4/coverage/atStripeDef.par.) The spectroscopic targets (galaxies and quasars) will be selected in the same way as for SDSS-I. The data quality criteria will be the same as for SDSS-I.

SEGUE intends to scan approximately 3500 square degrees of sky outside of the North Galactic Cap in a pattern such that no part of the sky with declination greater than –20 degrees is more than 20 degrees away from a stripe. The pattern includes scans that pass through the Galactic plane, but there is no requirement for the quality of data in fields where the SDSS photometric pipeline fails because of varying background or excessive image crowding. Approximately 200 spectroscopic tiles will be observed spectroscopically. Within each tile, approximately 1200 stars will be selected with a uniform algorithm to achieve specific goals, e.g. measuring the velocity and metallicity distributions in the Galactic halo, sampling the thick disk - spheroid interface at higher Galactic latitudes, and measuring the initial mass function and age distribution for stars in diverse regions. One hundred and thirty-five of the tiles will uniformly probe the Milky Way at all accessible longitudes and latitudes, and 65 will sample specific directions, such as well-calibrated open clusters. The plan for the SEGUE stripes and tiles is available at: http://home.fnal.gov/~yanny/fut/layout.html.

SN intends to scan repeatedly the celestial equator from RA = 20h to RA = 4h in September, October, and November in each of the three years, with a time-sampling that is as dense as possible, where an increasing fraction of the time is yielded to the other surveys in November. These observations will yield light curves for numerous variables, including about 60 Type Ia supernovae per season. These events will be announced as quickly as possible to enable spectroscopic follow-up with other telescopes.

Overview of the Integrated Baseline Plan

In the three years of SDSS-II operations, the goal is to complete the science outlined above for all three surveys. Two of the surveys are in opposite regions of the sky (Legacy and SN), and the third (SEGUE) requires imaging and spectroscopy at all seasons.

The SDSS-I experience allows us to compute average weather conditions and average observing efficiency. For time that is astronomically useful, it also allows us to compute the average of that time that can be used for imaging (photometric skies and good seeing). These average values are adopted to scale the available time into expected values for survey progress in units that can be compared against the survey goals, e.g. square degrees of sky and number of spectra.

For SEGUE, each of the 200 tiles on the sky is observed with two plates, one with a relatively short exposure for the brighter stars, and one with a relatively longer exposure for the fainter stars. We have determined that the net observing time (including overhead for swapping plates, etc.) required for one SEGUE plate pair is about 4.8 hours. (Note that the tables below refer to tiles, as opposed to plates.)

For imaging, we adopt the metric of "unique" square degrees. These are square degrees that have been corrected for overlaps of the scan lines in each of the two strips of a stripe, as well as for the end-to-end overlap where different runs of the same strip have been spliced together. "Unique" square degrees does not account for the "barrel-stave" overlap of the system of stripes for Legacy - that is accounted for in the "footprint" category. For SEGUE, the stripes are distinct and "unique" and “footprint” are equivalent.

A model observing plan has been devised that apportions time to the three surveys as a function of month of year, for each of the three years. The available time is dark time corrected for weather, minus one dark run in July/August for mirror re-aluminization and other maintenance. The demands by each of the three surveys in each month are defined by the following protocols:

1) If an unobserved Legacy stripe or spectroscopic plate is available in a part of the North Galactic Cap between stripes 10 and 37 that is currently accessible, observe that stripe or plate.

2) September, October, and most of November are allocated to the Supernova survey, where imaging is attempted even in spectroscopic conditions. The right ascension range of the Supernova survey is from 20 h to 4 h; whenever this area is not accessible for at least 1.5 hours at an hour angle of less than 3.25 h, the time is given to SEGUE (e.g., the ends of the nights later in the Fall). Some smaller amount of time may be given to SEGUE in September and October so that SEGUE can obtain stripes and tiles at lower declination that can best be obtained in those months.

3) All other time is given to SEGUE. The choice between imaging and spectroscopy depends on atmospheric conditions (imaging if photometric, good seeing, and dark) and availability of sky. The imaging for a region of sky must proceed the spectroscopy, which is why there is no SEGUE imaging in 2008. In any month, the fraction of the astronomically useful time allocated for imaging never exceeds 23%, based on experience with SDSS-I.

As the Legacy footprint is filled in, the demands for time by Legacy as a function of month will change, and this development of the footprint is not predictable. The present unobserved area between stripes 10 and 37 can be seen at http://www.sdss.org/status/imagingStatus.gif
and http://www.sdss.org/status/survey_area_covered_23.gif.

The model assumes something definite for filling in the Legacy footprint in order to create a definite baseline plan. In detail, the 2005 and 2006 profile for Legacy assumes a distribution of time by month based roughly on the distribution of Right Ascension for the remaining area. In 2007 and 2008, the 2005 and 2006 time for Legacy is reduced by a factor of 1.23. Thus the baseline plan calls for faster completion of Legacy in the North Galactic Cap than for the completion of SEGUE tiles in the same region of sky, but this balancing can be adjusted each year. The important part of the baseline is what each survey eventually yields by July 2008.

The model observing plan is a table of available hours per month, from 1 January 2005 to 30 June 2008, for each of the three surveys. To compute how many square degrees per hour are to be expected, we multiply the hours by 12.5 (as opposed to 18.75, which is the scan rate). The more conservative number corrects for inefficiencies and data that are collected but which do not pass the quality criteria. For Legacy, to compute the number of plates per hour, we adopt 1.8 hours per plate. Again, this is a conservative number based on SDSS-I experience that includes a correction for time spent obtaining plates in poor conditions with resulting longer exposures. As mentioned earlier, the number of SEGUE tiles is computed by assuming that each plate pair (SEGUE tile) requires 4.8 hours.

Legacy Survey Baseline

The baseline schedule for the Legacy survey is presented in Table 1 for imaging and for spectroscopy. Figures 1 and 2 present the same information in graphical form. As of 1 July 2005, approximately 200 square degrees remain to be completed for Legacy, and approximately 500 spectroscopic tiles.

Table 1. SDSS-II Baseline Projection – Legacy Survey

Period	Unique Imaging Area (sq. deg.)	Number of Spectroscopic Tiles
2005		
Q3	41	6.1
Q4	125	18.7
2006		
Q1	0	105.5
Q2	0	80.6
Q3	0	6.1
Q4	0	18.7
2007		
Q1	0	85.7
Q2	0	65.4
Q3	0	4.9
Q4	0	15.2
2008		
Q1	0	85.7
Q2	0	65.4
Total	166	558

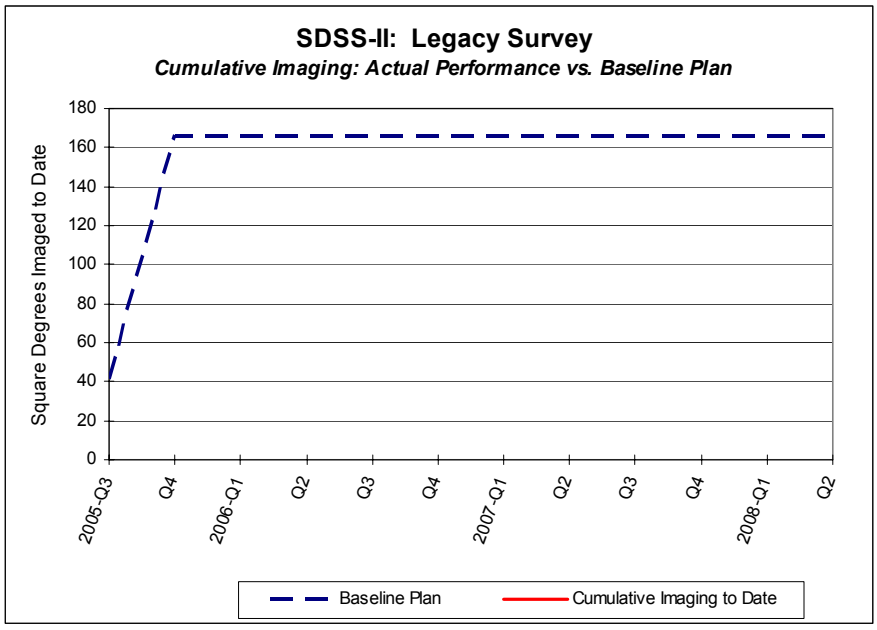

Figure 1. Baseline Imaging Schedule for the SDSS-II Legacy Survey

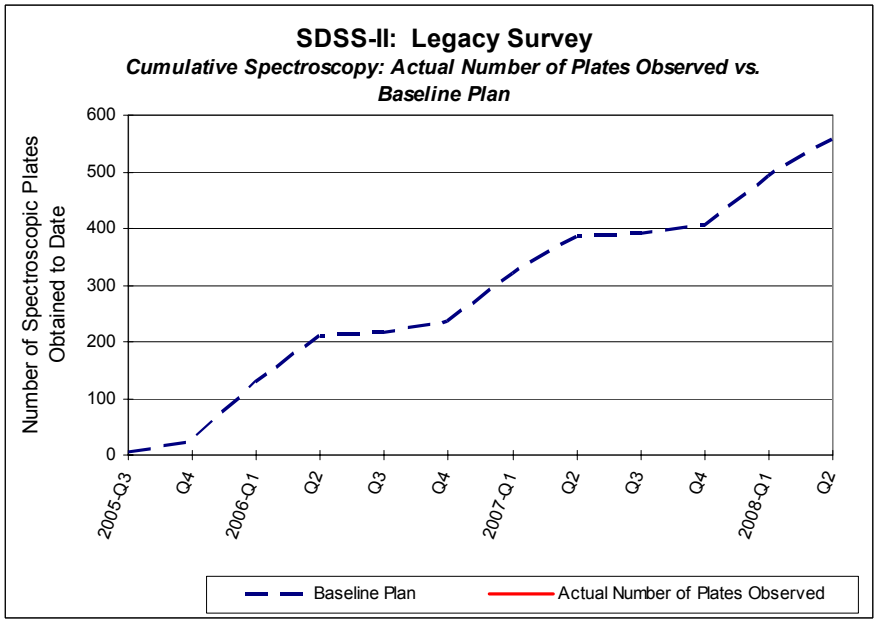

Figure 2. Baseline Spectroscopy Schedule for the SDSS-II Legacy Survey

SEGUE Survey Baseline

The baseline schedule for the SEGUE survey is presented in Table 2 for imaging and for spectroscopy. Figures 3 and 4 present the same information in graphical form. Although the SEGUE Survey goals are 3500 square degrees and 200 tiles, the projection in Table 2 shows a slightly smaller number for the imaging area. This is because the table covers the period from July 2005 through June 2008 and does not include SEGUE imaging data acquired prior to this period.

Table 2. SDSS-II Baseline Projection – SEGUE Survey

Period	Unique Imaging Area (sq. deg.)	Number of Spectroscopic Tiles
2005		
Q3	201	11.2
Q4	306	17.1
2006		
Q1	460	15.2
Q2	225	12.5
Q3	210	11.8
Q4	430	17.1
2007		
Q1	535	21.4
Q2	303	16.9
Q3	215	12.1
Q4	435	18.3
2008		
Q1	0	30.3
Q2	0	21.9
Total	3320	205.8

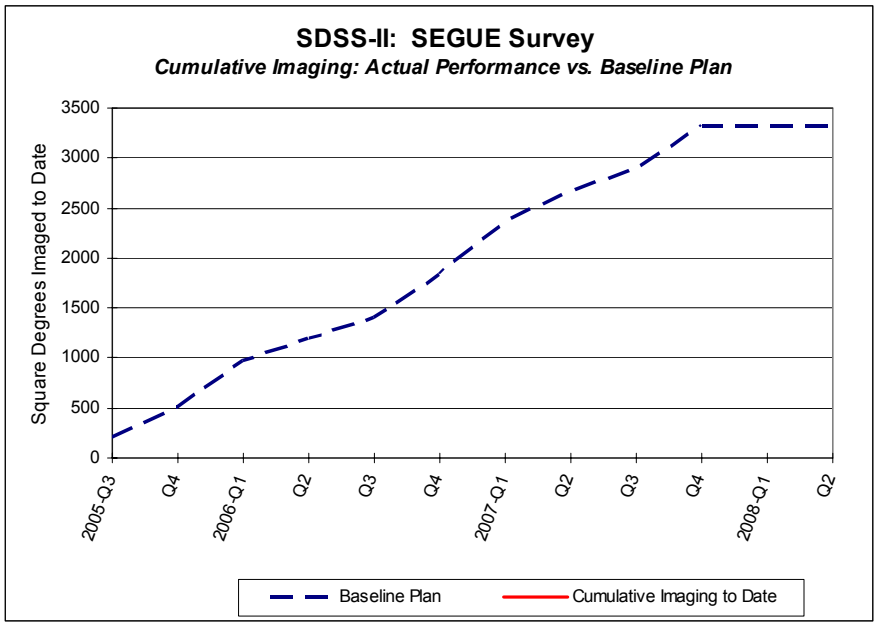

Figure 3. Baseline Imaging Schedule for the SDSS-II Legacy Survey

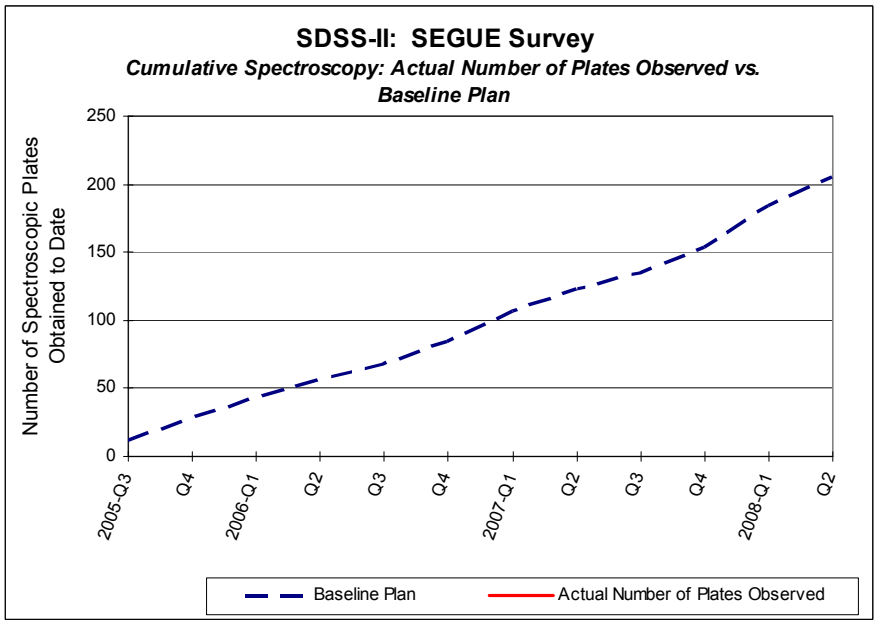

Figure 4. Baseline Spectroscopy Schedule for the SDSS-II Legacy Survey

SN Survey Baseline

For the SN survey, the model baseline observing plan allocates a certain number of hours useful for observing in the months September, October, and November, the same for 2005, 2006, and 2007 (ignoring details related to the lunations). The model assumes that time normally used for

spectroscopy is useful for SN imaging. For September, 10% of the available time is allocated for SEGUE, and this time is included in the Q3 baseline projection for SEGUE in Table 2. Similarly, for October 15% and for November 25% of the time is so allocated; this time for SEGUE is included in the Q4 baseline projection for SEGUE in Table 2.

The specific time for SEGUE in September and October in practice will be scheduled by the Head of Survey Coordination, taking into account the needs of both SEGUE and SN. The values of 10% and 15% for September and October, respectively, are estimates of the average amounts of time needed by SEGUE in those months. For November, the value of 25% reflects both the time not useable by SN because of airmass constraints, plus a lowered need for dense sampling at the end of the season.

After these allocations of time for SEGUE in the months of September, October, and November, the baseline model provides for 80 hours for SN in September, 83 hours in October, and 79 hours in November. These times are already corrected for inefficiencies, and so can be converted to square degrees by multiply by 18.75 square degrees per hour. In addition to this time, SN will observe during bright time, which will increase the hours quoted above by a factor of 1.25. In total, the model provides, on average, complete coverage of the 300 square degree area 19 times per season. In practice, some parts of the footprint will be covered more often and some less often, of course.

Appendix B

Level-4 Work Breakdown Structure (WBS)

WBS	Activity	Responsible
1	**Survey Management**	**Rich Kron**
1.1	ARC Administration	Mike Evans
1.2	Office of the Director	Rich Kron
1.3	Office of the Project Scientist	Jim Gunn
1.4	**Office of the Project Manager**	**Bill Boroski**
1.4.1	Project Management Office	Bill Boroski
1.4.2	**Project Milestones**	**Bill Boroski**
1.4.3	**Data Release Milestones**	**Bill Boroski**
1.4.4	**Summer Shutdown Periods**	**Bill Boroski**
1.5	Office of the Scientific Spokesperson	Michael Strauss
2	**Survey Operations**	Jim Gunn,Bill Boroski,Steve Kent
2.1	**Observing Systems**	Jim Gunn,Bill Boroski
2.1.1	Technical Support at APO	Bill Boroski
2.1.2	Off-mountain Technical Support	Bill Boroski
2.1.3	Plug Plate Production	Mike Evans
2.1.4	ARC Support for Observing Systems	Mike Evans
2.2	**Observatory Operations**	Bruce Gillespie
2.3	**Data Processing**	Chris Stoughton
2.3.1	**Data Processing Operations**	Chris Stoughton
2.3.1.1	Legacy Data Processing	Brian Yanny
2.3.1.2	SEGUE Data Processing	Brian Yanny,Jill Knapp
2.3.1.3	Supernova Data Processing	Josh Frieman
2.3.2	**Software and Data Processing Support**	Michael Strauss
2.4	**Data Distribution**	Bill Boroski
2.4.1	**Data Distribution Operations**	Brian Yanny
2.4.1.1	Legacy Data Distribution	Brian Yanny
2.4.1.2	SEGUE Data Distribution	Brian Yanny
2.4.1.3	Supernova Data Distribution	Josh Frieman
2.4.2	**Data Archive Development and Support**	Alex Szalay
2.5	**Survey Coordination**	**Steve Kent**
2.5.1	Legacy Survey Coordination	Steve Kent,Michael Strauss
2.5.2	**SEGUE Survey Coordination**	**Connie Rockosi,Brian Yanny**
2.5.3	Supernova Survey Coordination	Josh Frieman,Craig Hogan
2.6	**ARC Support for Survey Operations**	Mike Evans
3	**New Development**	Rich Kron
3.1	**SEGUE Project Development**	**Connie Rockosi,Brian Yanny**
3.1.1	**SEGUE Survey Planning and Coordination**	**Connie Rockosi,Brian Yanny**
3.1.1.1	**Segue Science Requirements**	**Connie Rockosi,Brian Yanny**
3.1.1.2	**SEGUE Survey Stategy**	**Connie Rockosi,Brian Yanny**
3.1.1.3	**SEGUE Qualilty Assurance Program**	**Connie Rockosi,Brian Yanny**
3.1.2	**SEGUE Target Selection**	**Connie Rockosi,Brian Yanny**
3.1.2.1	**SEGUE Target Selection Web Page**	**Connie Rockosi,Brian Yanny**
3.1.2.2	**SEGUE Target Selection Code Changes**	**Connie Rockosi,Brian Yanny**
3.1.3	**Very-Low-Latitude Target Selection and Data Processing Analysis**	**Connie Rockosi,Brian Yanny**
3.1.4	**Refined Derived-Parameters Determinations and Theory/Simulations**	**Connie Rockosi,Brian Yanny**
3.1.5	**Calibrations/Catalogs of Spectroscopy of Stars of Known Metalicity**	**Connie Rockosi,Brian Yanny**
3.1.6	**SEGUE Data Processing Software Development**	**Connie Rockosi,Brian Yanny**
3.1.6.1	**SEGUE Spectro-1D Pipeline**	**Mark SubbaRao**
3.1.6.2	**SEGUE Spectro-2D Pipeline**	**Craig Loomis**
3.1.6.3	**SEGUE Stellar Atmosphere Parameter Code**	**Tim Beers**
3.1.6.4	**Incorporate Proper Motions into Stellar Parameters**	**Jeff Munn,Sebastian Lepine**
3.1.6.5	**SEGUE Spectro Parameter Flat File Format**	**Brian Yanny**
3.1.6.6	**SEGUE Stellar Atmosphere Parameter Pipeline**	**Sivarani Thirupathi**
3.1.6.7	**Photo Pipeline Modifications for Crowded Field Data**	**Robert Lupton**
3.1.7	**SEGUE Database Development**	**Ani Thakar**
3.1.8	**SEGUE Technical Papers**	**Connie Rockosi,Brian Yanny**
3.1.8.1	**SEGUE Target Selection Technical Paper**	**Connie Rockosi,Brian Yanny**
3.1.8.2	**SEGUE Stellar Parameter Technical Paper**	**Tim Beers**

Level-4 WBS (continued)

WBS	Activity	Responsible
3.2	**Supernova Project Development**	Josh Frieman
3.2.1	**SN Survey Planning and Coordination**	Josh Frieman
3.2.1.1	**SN Science Requirements Document**	**Josh Frieman**
3.2.1.2	**SN Quality Assurance Plan**	**Rick Kessler**
3.2.1.3	**SN Software Requirements Document**	**Josh Frieman**
3.2.1.4	**SN Proposal for Bright-time Operations in 2005-07**	**John Marriner**
3.2.1.5	**2.5m SN Observing Plans**	**Steve Kent**
3.2.1.6	**SN Project Operations Plan**	**Fritz DeJongh**
3.2.1.7	**SN Software Development Plan**	**Fritz DeJongh**
3.2.1.8	**SN On-mountain Computer Hardware Plan**	**Fritz DeJongh**
3.2.1.9	**APO Computer Room Cooling Upgrade Plan**	**Bruce Gillespie**
3.2.1.10	**SN Off-mountain Computer Hardware Plan**	**Hubert Lampeitl**
3.2.1.11	**SN Database Development Plan**	**Hubert Lampeitl**
3.2.1.12	**SN Candidate Rapid Dissemination Plan**	**John Marriner**
3.2.1.13	**Coordination of Follow-up Observations**	**Josh Frieman**
3.2.1.14	**SN Public Dissemination Plan**	**Chris Stoughton**
3.2.2	**SN Project Computing Hardware Implementation**	Josh Frieman
3.2.2.1	**APO Computer Room Cooling Upgrade**	**Bruce Gillespie**
3.2.2.2	**SN On-mountain Computer Hardware Implementation**	**Fritz DeJongh**
3.2.2.3	**SN Off-mountain Computer Hardware Implementation**	**Hubert Lampeitl**
3.2.2.4	**Supernova Database Computer Hardware Implementation**	**Chris Stoughton**
3.2.2.5	**SN Public Archive Computer Hardware Implementation**	**Chris Stoughton**
3.2.3	**SN Software Development for 2.5m Survey Operations**	Josh Frieman
3.2.3.1	**SN Software Script Development**	**Rick Kessler**
3.2.3.2	**Improved Stripe 82 Photo-Z Implementation**	**Erin Sheldon**
3.2.3.3	**PHOTO Module Improvements (only if necessary to meet processing-time req.)**	**Rick Kessler**
3.2.3.4	**SN Software Tools**	**Ben Dilday**
3.2.3.5	**Frame Subtraction Pipeline Development**	**Fritz DeJongh**
3.2.3.6	**Co-Added Template Frames (enhanced goal)**	**Josh Frieman**
3.2.3.7	**Production and preparation of Templates**	**Josh Frieman**
3.2.3.8	**I-Band Frame Subtraction**	**Fritz DeJongh**
3.2.3.9	**Forced Object Measurement**	**Fritz DeJongh,Andy Becker**
3.2.3.10	**Veto Catalogs and Objects Database**	**Hubert Lampeitl**
3.2.3.11	**SN Candidates Database**	**Hubert Lampeitl**
3.2.3.12	**doObjects Pipeline**	**Hubert Lampeitl**
3.2.3.13	**HandScan Tool Development**	**Hubert Lampeitl**
3.2.3.14	**Target Selection Development**	**Josh Frieman**
3.2.3.15	**Selection Criteria**	**John Marriner**
3.2.3.16	**Target Selection Web Interface**	**John Marriner**
3.2.3.17	**Public SN Candidate Web Server**	**John Marriner**
3.2.4	**Software Development for Follow-up Observations**	Josh Frieman
3.2.4.1	**Follow-up Candidates and Observed Objects Database**	**John Marriner**
3.2.4.2	**SN Observing Tools**	**John Marriner**
3.2.4.3	**SN Typing Tools**	**Juan Estrada**
3.2.4.4	**Auxiliary Imaging Data Reduction Tools**	**Hubert Lampeitl**
3.2.4.5	**SN Intercalibration Framework**	**Hubert Lampeitl**
3.2.5	**Software Development for SN Off-mountain Analysis**	Josh Frieman
3.2.5.1	**SN Photometry Pipeline**	**Hubert Lampeitl**
3.2.5.2	**Improved Stripe 82 Object/Image Calibrations**	**Juan Estrada**
3.2.6	**SN Database Development**	Josh Frieman
3.2.6.1	**Collaboration Archive of Repeat Imaging Data and/or Catalogs**	**Chris Stoughton**
3.2.6.2	**Public Archive of Repeat Imaging Data and/or Catalogs**	**Chris Stoughton**
3.2.6.3	**SN Database Development**	**Hubert Lampeitl**
3.3	**Photometric Calibration Development**	Jill Knapp

Level-4 WBS (continued)

WBS	Activity	Responsible
3.4	**Data Acquisition Upgrade**	Kurt Biery
3.4.1	**DA Upgrade Planning**	**Bill Boroski**
3.4.1.1	**DA Upgrade Functional Specification**	**Don Holmgren**
3.4.1.2	**DA Upgrade Test Plan**	**Kurt Biery**
3.4.1.3	**DA Upgrade Commissioning Plan**	**Don Holmgren**
3.4.2	**DA Hardware Procurements**	**Bill Boroski**
3.4.3	**DA Software Development**	**Margaret Votava**
3.4.3.1	**VxWorks Environment**	**David Slimmer**
3.4.3.2	**VxTools Mods**	**David Slimmer**
3.4.3.3	**Emulation Code Development**	**Kurt Biery**
3.4.3.4	**Archiver Mods**	**Fritz Stauffer**
3.4.3.5	**Murmur Portability Check**	**Margaret Votava**
3.4.3.6	**Network Time Protocol (NTP)**	**Fritz Stauffer**
3.4.3.7	**ftelnet Tests**	**Craig Loomis**
3.4.3.8	**Port Infrastructure Code to "host2"**	**Margaret Votava**
3.4.3.9	**Port Observing Tools to "host2"**	**Eric Neilsen**
3.4.3.10	**IOP code modifications**	**Eric Neilsen**
3.4.3.11	**Potential Astroline Modifications**	**Kurt Biery**
3.4.3.12	**sdssmth Upgrade**	**Eric Neilsen**
3.4.3.13	**TPM Modifications**	**Peregrine Mc Gehee**
3.4.4	**DA Upgrade Testing at Fermilab**	**Kurt Biery**
3.4.4.1	**FNAL Test Stand Verification**	**Kurt Biery**
3.4.4.2	**DA System Testing at FNAL**	**Kurt Biery**
3.4.5	**DA Upgrade Preps at APO**	**Fritz Stauffer**
3.4.5.1	**DA Preliminary Development and Testing at APO**	**Fritz Stauffer**
3.4.5.2	**APO Site Preparations**	**Craig Loomis**
3.4.5.3	**DA Upgrade Hardware/Software Installation at APO**	**Fritz Stauffer**
3.4.6	**DA Upgrade Commissioning**	**Bill Boroski**
3.4.7	**Final As-built Documentation**	**Margaret Votava**
3.4.8	**DA Upgrade Tape Drive Replacement**	**Bill Boroski**
4	**ARC Corporate Support**	Mike Evans
5	Education and Public Outreach	Julie Lutz
6	Management Reserve	Rich Kron

Appendix C

ARC Work Agreements by Institution

Institution	Agreement	Description	Manager
ARC	SSP-221	ARC Secretary and Treasurer	M. Evans
	SSP-234	ARC Business Manager	M. Evans
	SSP-291	ARC Corporate Accounts	M. Evans
Fermilab	SSP-140	SEGUE and Supernova Survey Development	S. Kent
	SSP-161	Data Acquisition Upgrade	D. Petravick
	SSP-240	Data Processing and Distribution	S. Kent
	SSP-242	Observing Systems Support	W. Boroski
	SSP-248	Survey Management Support (Proj. Manager)	W. Boroski
	SSP-261	Observing Programs and DA Support	D. Petravick
	SSP-268	Data Distribution Operations	M. Kaletka
Japan Participation Group	SSP-256	Observing Systems Support	Y. Suto
Johns Hopkins University	SSP-237	Data Archive Development and Support	A. Szalay
New Mexico State	SSP-235	NMSU Site Support	B. Gillespie
Princeton University	SSP-138	SEGUE Survey Development	J. Gunn
	SSP-232	Observing Systems Support	J. Gunn
	SSP-238	Software and Data Processing Support	M. Strauss
	SSP-246	Survey Management Support (Proj. Scientist)	J. Gunn
Univ. of Chicago	SSP-139	Supernova Survey Development	J. Frieman
	SSP-239	Software and Data Processing Support	J. Frieman
	SSP-267	Survey Management Support (Director)	R. Kron
Univ. of Washington	SSP-231	Observing Systems Support	M. Evans
	SSP-270	EPO Coordinator	J. Lutz
Los Alamos National Laboratory	SSP-258	Observing Systems Support	P. McGehee
Michigan State University	SSP-269	SEGUE Survey Development	T. Beers
United States Naval Observatory	SSP-257	Software and Data Processing Support	J. Pier

Appendix D

SDSS-II Cost Control Structure (CCS)

1. Survey Management
- 1.1. ARC Administration
  - SSP-221 - ARC Secretary Treasurer
  - SSP-234 - ARC Business Manager
- 1.2. Office of the Director
  - SSP-267 - UC Support for Survey Management
- 1.3 Office of the Project Scientist
  - SSP-246 - Princeton Support for Survey Management
- 1.4 Office of the Project Manager
  - SSP-248 - Fermilab Support for Survey Management
- 1.5 Scientific Spokesperson
  - SSP-291a - Support for Public Affairs
  - SSP-291b - ARC Support for the Spokesperson
  - SSP-291c - ARC Support for Collaboration Affairs

2. Survey Operations
- 2.1 Observing Systems
  - 2.1.1. Technical Support at APO
    - SSP-242 - FNAL Observing Systems Support
  - 2.1.2. Off-mountain Technical Support
    - SSP-261 - FNAL Observing Programs and DA Support
    - SSP-231 - UW Observing Systems Support
    - SSP-232 - PU Observing Systems Support
    - SSP-257 - USNO Observing Systems Support
    - SSP-258 - LANL Observing Systems Support
    - SSP-256 - JPG Observing Systems Support
  - 2.1.3. Plug-plate Production
    - SSP-231 – UW Observing Systems Support
  - 2.1.4. ARC Support for Observing Systems
    - SSP91d – ARC Observing Systems Support
- 2.2. Observatory Operations
  - SSP-235 – APO Site Support
- 2.3. Data Processing
  - 2.3.1. Data Processing Operations
    - SSP-240 – FNAL Software and Data Processing Support
  - 2.3.2. Software and Data Processing Support
    - SSP-238 – PU Software and Data Processing Support
    - SSP-239 – UC Software and Data Processing Support
    - SSP-269 – MSU Software and Data Processing Support
    - SSP-257 – USNO Software and Data Processing Support
- 2.4. Data Distribution
  - 2.4.1. Data Distribution Operations
    - SSP-240 – FNAL Software and Data Distribution Support
    - SSP-268 – FNAL Data Distribution Operations
  - 2.4.2. Data Archive Development and Support
    - SSP-237 – JHU Data Archive Development and Support
- 2.5. Survey Coordination
  - SSP-240 – FNAL Software and Data Processing Support
- 2.6. ARC Support for Survey Operations
  - SSP-291f – Additional Scientific Support
  - SSP-291h – Observers' Research Fund

3. New Development

3.1. SEGUE Survey Development

SSP-138 – PU SEGUE Software Development
SSP-140 – FNAL SEGUE Development
SSP-237 – JHU Data Archive Development and Support
SSP-268 – FNAL Data Distribution Support
SSP-269 – MSU SEGUE Software Development

3.2. Supernova Survey Development

SSP-139 – UC Supernova Survey Development
SSP-140 – FNAL Supernova Development
SSP-231 – UW Supernova Survey Development
SSP-235 – APO Computer Room Upgrade

3.3. Photometric Calibration

SSP-138 – PU Software Development

3.4. Data Acquisition Upgrade

SSP-161 – FNAL DA Upgrade Support

4. ARC Corporate Support

SSP91e - Corporate Support

5. Education and Public Outreach

SSP-270 – ARC Support for EPO Coordinator
SSP-291i – ARC Support for Public Information Officer

6. Management Reserve

SSP-291 - Management Reserve

Appendix E

SDSS-II Closeout Plan and Budget

INTRODUCTION

This document describes the closeout plan for the Sloan Digital Sky Survey II (SDSS-II). Observing operations for the 3-year Survey are scheduled to end on June 30, 2008. At the completion of observing operations, equipment and systems at APO will be prepared for long-term storage while the last of the acquired data is processed, calibrated, and loaded into databases in preparation for the final data release. The final data release is currently scheduled for September 30, 2008 and will mark the end of all SDSS-II infrastructure work. Work following the final data release will consist of settling final invoices, closing financial accounts, and writing final project reports. This work will be performed by the Director, Project Manager, and ARC Business Manager and will be completed by the end of November 2008. It is envisioned that the Director will present a project closeout report at the November 2008 meetings of the ARC Advisory Council and Board of Governors.

The following assumptions have been made in preparing this closeout plan:

1. At the completion of observing operations, the 2.5m telescope, 0.4m Photometric Telescope, imaging camera, spectrographs, data acquisition system, and all supporting sub-systems will be prepared for long-term storage at Apache Point Observatory.
2. Long-term loan agreements or property transfers will be executed between ARC and the participating institutions for equipment or systems that will remain in long-term storage at APO.
3. Data processing operations will be automated to the point that new data is processed, calibrated, and loaded into databases within 6 weeks of its acquisition.
4. Final data processing and calibration will occur with the same pipeline and software versions used for DR7. There will be no final overall reprocessing or calibration of the data archive.
5. The final data release will occur using the same database tools used for DR7. No new features will be incorporated with the final release.
6. Fermilab will serve as the interim steward of the SDSS and SDSS-II data archives, until a permanent long-term steward is identified and the archive successfully transferred. It is anticipated that a long-term steward will be identified within twelve months of the end of survey operations. In the interim, this service will be provided as an in-kind contribution to ARC.
7. Princeton will serve as the interim steward of the SDSS and SDSS-II mail archives until a permanent long-term steward is identified and the archives successfully transferred. It is anticipated that a long-term steward will be identified within twelve months of the end of survey operations. In the interim, this service will be provided as an in-kind contribution.

CLOSEOUT PLAN TIMELINE

Closeout activities will start in earnest in early July 2008 and end with a final report to the Advisory Council in late November 2008. Figure 1 presents a summary view of the time line for the project closeout. Subsequent sections of this document describe the scope of work and budget in greater detail.

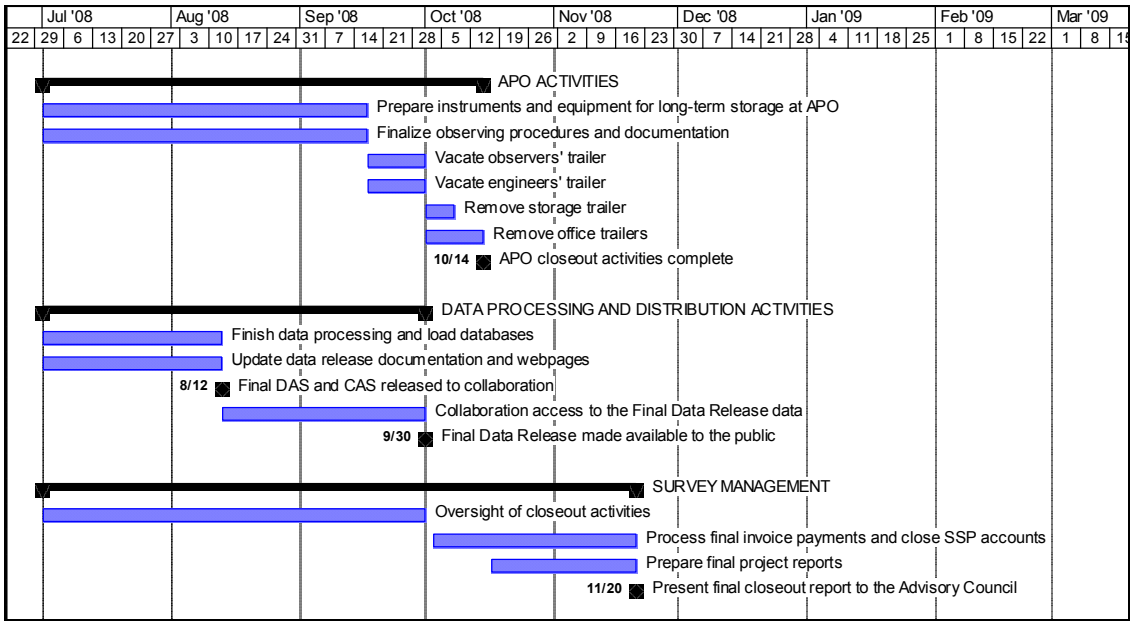

Figure 1. Closeout Plan Timeline.

CLOSEOUT BUDGET

The cost forecast to close out the SDSS-II project is $830K and consists of $95K of in-kind contributions from Fermilab and $735K of ARC-funded expenses. Table 1 presents the current forecast for the closeout budget by WBS category.

Table 1. SDSS-II Closeout Budget ($K)

	ARC-Funded Budget	*In-kind Contribution*	*Total*
Survey Management	90	70	160
Observing Systems	105	0	105
Observatory Operations	333	0	333
Data Processing and Distribution	158	25	183
ARC Corporate Support	14	0	14
Sub-total	700	95	795
Management Reserve	35	0	35
Total	735	95	830

SURVEY MANAGEMENT

Survey management activities will be performed by the Director, Project Manager, and ARC Business Manager, with support from their administrative staff. The Director and Project Manager will oversee final data processing and distribution activities. They will also oversee closeout activities at APO and the relocation of machine tools from APO to Fermilab. Finally, they will be responsible for preparing

the 2008-Q3 and final project reports. The Business Manager will be responsible for managing ARC corporate affairs, negotiating long-term property loans or transfers, processing final invoice payments, closing ARC SSP accounts, disposing of ARC-purchased equipment (e.g., computers), and satisfying final funding agency reporting requirements.

The ARC-funded budget will cover the following expenses:

- 75% of the salary cost for the Business Manager and 20% of the salary cost for administrative support staff for the period July 1 through November 30, 2008.
- One trip to APO by the Business Manager.
- Modest office supply costs for the Business Manager.
- One month of summer salary support for the Project Scientist
- Travel by the Director, Project Manager and Spokesperson associated with final data release and closeout activities.

It is anticipated that Fermilab will provide the salary of the Project Manager during the period July 1 through November 30, 2008 as an in-kind contribution. It is also anticipated that Fermilab will provide a modest amount of budget support for office supplies related to closeout activities.

In addition to the management and administrative activities just described, a number of other management activities associated with the project closeout will begin before the final three-month closeout period.

1. The Business Manager will assemble a list of all computers purchased with ARC funds and will coordinate the disposition of these assets in accordance with ARC policy. In some cases, it may be most appropriate to transfer ownership of a specific computer from ARC to a participating institution. In other cases, it may be most appropriate to reassign the computer within the ARC consortium. In all cases, the Business Manager will be responsible for documenting the final disposition of each computer in preparation for the final closeout audit.
2. The Project Manager will assemble a list of all non-computer assets (hardware and software) that are located at the various institutions that have participated in the construction, commissioning, and operation of the survey. The goals of this activity will be to assemble a comprehensive list of ARC-funded assets that will be of value to future possible observing operations and gather value assets together in a single location. An example of such assets is the plug plate drilling fixture and the plug plate QA measuring fixture. At the end of the survey, it will be advantageous to have this tooling shipped to APO as opposed to leaving the long-term storage of the fixturing to the UW machine shop.
3. The Project Manager will be responsible for organizing a documentation archive containing all documentation relevant to future continued operations of the SDSS equipment and systems at APO.

It is anticipated that these activities will be completed and turned over the ARC as part of the final project closeout.

COLLABORATION AFFAIRS

During the closeout period, the Spokesperson will work with the Management Committee, Collaboration Council and Working Group chairs to assist the process of final data research. A modest amount of travel support will be required to support this effort.

A technical paper describing the final data release will be prepared and submitted for publication to the Astronomical Journal. Page charges will be covered by ARC funds, which will be set aside in an ARC account for this purpose.

It is envisioned that a final collaboration meeting will be organized in the summer of 2009 to review the final state of the data archive. One possibility under consideration is to coordinate this collaboration meeting with a AAS meeting, at which for example, a Topical Session might be arranged to focus on the analysis of the galaxy power spectrum for the full data set. In any case, ARC-funding will not be used to cover meeting expenses. If a collaboration meeting is held, it should sustain itself with a registration fee. If a collaboration meeting is held in conjunction with the AAS meeting, individuals will be responsible for paying their own expenses.

The ARC-funded budget will cover the following expenses:

- Travel expenses for the Spokesperson
- Final data release page charges

OBSERVING SYSTEMS

Observing Systems includes all equipment and systems used to support SDSS-II observing operations. The intent is to store equipment and systems in a manner that will allow their use in the future, should funding become available to support new observing operations. A list of this equipment will be assembled prior to the end of observing operations. The list will provide an inventory of ARC assets and will show current institutional ownership for those items associated with observing operations that were not purchased with ARC funds. Since it is not clear when the equipment will be used again, the ARC Business Manager will work with each institutional owner to negotiate long-term loan arrangements or permanent property transfers to ARC.

In consultation with the Project Scientist and Project Manager, the Telescope Engineer will be responsible for preparing equipment and systems at APO for long-term storage. A careful assessment of each system will be performed and the appropriate means of storage will be determined and implemented. As a starting point, it is anticipated that the SDSS imaging camera will be prepped and moved into the clean room of the APO operations building. The spectrographs will remain mounted to the 2.5m telescope, however, it may be appropriate to remove spectrograph optics and cameras and store them in the APO instrument lab. Data acquisition system computers, tape drives, and other components will be powered down and left in place. The outside manipulator and its rails will be removed and placed inside the SDSS support building. Existing spare parts will be inventoried, removed from the Spare Parts Storage Trailer and placed into storage in the building currently housing plug plate operations. Systems documentation will be organized and finalized during the last six months of observing operations and will be handed over to the APO Site Director for long-term archival storage. The Engineering Office Trailer and will be emptied of all tools, documentation, and personal artifacts in preparation for trailer removal.

Machine tools were provided to APO by Fermilab to support observing operations. Fermilab will send machinists to APO to remove these tools and prepare them for shipment back to Fermilab.

Plug plates that have been observed are currently stored in a rented warehouse in Alamogordo. At the conclusion of observing operations, or earlier if possible, these plates will be removed from storage and surplused. The ARC Business Manager will be responsible for handling this transaction. Plug plates that have not been observed will be stored in the plug-plate operations lab at APO for possible future use.

The ARC-funded budget will cover the following expenses:

- Salary costs for technical staff at APO involved in closeout activities;
- Materials and supplies to prepare SDSS-II equipment and systems for long-term storage at APO.
- Travel and shipping costs related to the removal of Fermilab machine tools from the APO machine shop and their shipment back to Fermilab.
- Relocation costs for the Fermilab engineering staff in residence near APO. Relocation costs will cover moving expenses from New Mexico to the Fermilab area in accordance with the approved Fermilab relocation policy.

It is anticipated that Fermilab will provide the salary costs for technicians sent to APO to prepare machine tools for shipment back to Fermilab.

OBSERVATORY OPERATIONS

Observatory Operations includes APO infrastructure support and observer activities. During normal operations, the SDSS operating budget covers a fraction of infrastructure costs for services (e.g., cleaning, trash removal, maintenance); utilities (e.g., water, electricity, telecommunications); and supplies (e.g., cryogens, other miscellaneous). The closeout budget for Observatory Support will provide for 80% of cryogen costs, and 67% of the other infrastructure costs for the period July 1 through September 30, 2008.

The closeout budget provides up to three months of fully-loaded salary support for eight observers. The observers will be responsible for finalizing operating procedures, documenting final software versions, and other related tasks that will allow startup of operations at some point in the future. The observers will assist the project scientist with activities related to instrument storage preparation, and the engineering crew with closeout activities. The observers will be responsible for emptying the observers' office trailer of all personal items in preparation for trailer removal by September 30. Office furniture and computing equipment will be removed and disposed of by APO site staff.

The closeout budget will also provide partial salary support for specific members of the APO operations staff. The Site Director and Deputy Site Director will be responsible for overseeing site infrastructure support, including the removal of the engineers' and observers' office trailers. The Computer Systems Manager will support the decommissioning of all computer systems and networks associated with SDSS operations. The APO Deputy Telescope Manager, one technical writer, one data aide and housekeeper, and one maintenance tech will assist the SDSS Telescope Engineer with closeout activities.

ARC has a standing agreement with the U.S. Forest Service regarding the use of land for observatory operations. Under the existing agreement, ARC must maintain the exterior appearance of all observatory buildings. With the closeout of the SDSS project, it is understood that APO site staff will be responsible for the ongoing maintenance of the exterior of all SDSS facilities, with long-term funding provided by ARC. Funding for this on-going maintenance is not included in the SDSS closeout budget.

In summary, the ARC-funded budget will cover the following expenses:

- Up to three months of salary support for eight observers.

- Two months of salary support for the computer systems manager, one technical writer, one data aide, and one maintenance technician, at the 50% level.
- Three months of salary support for instrument support.
- Three months of salary support for the APO Site Director and Deputy, at the 50% level.
- Benefits at 26% and overhead at 26% for the aforementioned staff.
- Two months of rental on the spare parts storage trailer.
- Three months of rental for the observers' office trailer and engineer's office trailer.
- 67% of site service, utility, and supply costs for three months.
- 80% of liquid nitrogen costs for three months.

DATA PROCESSING AND DISTRIBUTION

Fermilab will provide scientific and technical staff to finish processing and calibrating the last of the survey science data collected in the second quarter of 2008, and to prepare for the final data release. The anticipated level of support at Fermilab is as follows:

- 1 FTE of scientist support
- 3.0 FTEs of computer professional support
- 1.45 FTE of database support

The data will be processed using the same pipeline versions and calibration procedures used for Data Release 7 (DR7). Calibrated data will be loaded into the same versions of the DAS and CAS used for DR7 and will be made available to the collaboration for evaluation and use as soon as possible. It is anticipated that the collaboration will have access to the final calibrated data by mid-August, 2008 and that the data will be made available to the general astronomy community by September 30, 2008. In addition to processing data and loading it into databases, Fermilab will provide the resources necessary to update the final release web pages as necessary to document the final data release.

Princeton and Johns Hopkins will provide ARC-funded technical staff to support the final data release. Princeton activities will include testing and evaluation on the final data set. JHU activities will include support for the final CAS load. The anticipated level of support for the final data release is as follows:

- 0.25 FTEs of Sr. Technical Staff support from Princeton.
- 0.25 FTEs of database support from Johns Hopkins.
- 0.25 FTEs of systems admin support from Johns Hopkins.

The final release of SDSS data in late September will mark the end of all infrastructure work associated with data processing. Subsequent data distribution activities will be related to maintaining the project website (www.sdss.org), serving up the data archive, and providing helpdesk support. It is anticipated that Fermilab will provide these services as an in-kind contribution until a permanent long-term steward is found and the data archive transferred.

Fermilab will make a permanent archive copy of the CVS repository used to store software used in SDSS and SDSS-II observing, data processing, and data distribution operations. It is anticipated that the archive copy will be maintained by Fermilab until a long-term steward is found for the data archive. At such time, the archived repository will be transferred to the long-term steward along with the data archive.

During the course of the SDSS baseline survey, Princeton has maintained the project mail archives, the problem-reporting database GNATS, and a CVS repository containing among other things, the

spectroscopic pipeline *idlspec2d*. It is anticipated that Princeton will continue to maintain the mail archive and problem-reporting database during the closeout period and for one month after the final data release. At such time, Princeton will make a final archive copy of all mail archives, the problem-reporting database, and the Princeton CVS repository and will provide the archive copy to Fermilab for interim storage along with the rest of the data archive. The estimated level of support is 0.5 FTE.

In summary, the total level of effort to support final data processing and distribution activities is 7.7 FTEs. The ARC-funded budget for data processing and distribution provides for the following expenses:

- Three months of salary support for the following personnel working at Fermilab on the final release: 0.5 FTEs of post-doc support and 2.75 FTEs of computer professional support.
- Three months of salary support for a post-doc at Princeton to support the mail archives and problem-reporting database (0.5 FTE).
- Three months of salary support for senior technical staff at Princeton (0.25 FTE).
- Three months of salary support for technical staff at JHU to support the final release. (0.5 FTE).

It is anticipated that Fermilab will provide three months of salary support for one FTE of scientist support an in-kind contribution to ARC.

Not included in the closeout budget is the value of Fermilab's in-kind contribution for the interim maintenance of the SDSS data archive after the official project termination and until a permanent long-term steward is found. This includes storage of the raw data tapes, maintenance of the SDSS website, maintenance of the SDSS and SDSS-II data archives, and serving SDSS-II data through the DAS and CAS interfaces. It also includes helpdesk support for the data archive.

Also not included in the closeout budget is the value of Princeton's in-kind contribution for one month of interim support after September 30 for the maintenance and support of the mail archives and the problem-reporting database, or the value of in-kind salary support for senior scientists at participating institutions who will likely provide support for the final data release.

ARC CORPORATE SUPPORT

Corporate support affairs will be handled and managed by the ARC Business Manager. We do not anticipate incurring any legal expenses as part of the SDSS-II closeout. Anticipated corporate expenses included in the ARC-funded budget include the following:

- Three months of insurance
- CPA audit and closeout fees
- Removal costs for the engineers' and observers' office trailers

ARC financial records are audited on an annual basis by an external audit firm. The audit normally occurs after the ARC fiscal year ends on December 31. However, since we plan to close out the SDSS project in November 2008, we plan to arrange for an external audit of SDSS-II financial records in early November, once most invoices have been received and processed. Estimated audit fees are included in the ARC-funded closeout budget.

The Business Manager will administer the contract for removing the engineers' and observers' office trailers from APO. It is anticipated that the observers will complete their work and vacate their office trailer by August 30 and that the engineering staff will complete their work and vacate their office

trailer by September 30. Office equipment in the trailers will be removed and/or disposed of by the APO site staff. The trailers will be prepped for removal by the APO site staff such that the trailers will be removed from the site by October 30. In consultation with the ARC Business Manager, the APO Site Director will be responsible for securing the contracts to remove the trailers and perform site restoration. The area occupied by the Observers' Trailer will be restored to its original condition, with all utilities properly removed and/or terminated. The area occupied by the Engineers' Trailer will be left as a gravel pad with all utilities left intact in a secure and safe manner.

MANAGEMENT RESERVE

The management reserve budget is set at approximately 4% of the ARC-funded closeout budget. Management reserve will be controlled by the SDSS Director.

Appendix F

Updated Total Project Budget

The original project scope of work was budgeted at $14.9M (total cash + in-kind) and appears as Table 2.1 in the SDSS-II Project Execution Plan (PEP). This was the budget presented to the Alfred P. Sloan Foundation and the National Science Foundation.

After the proposals were submitted, we succeeded in raising cash beyond our funding-raising goal by adding new partners to the project. The extra cash allows us to address some areas of the project that we had under scoped, most especially the contingency (Management Reserve), which was only $305K out of the $14.9M (Table 2.1).

The amount of additional cash resources not only provides for an adequate level of contingency, but it also allows us to expand the scope of work of the project by adding what we call "New Projects." Recognizing this potential, the NSF requested us to devise a plan to address it; our response to that is Section 11 of the PEP. The increase in the scope of work of the SDSS-II, and correspondingly in the budget, was approved by the Advisory Council-II at its meeting in October 2005.

This Appendix documents the new budget and describes in more detail the mechanism for establishing the balance between the Management Reserve and the New Projects for each annual budget request.

Table F.1 shows the cost forecast for the three-year survey including the total resources raised. The total is $16.27M, which includes $1.165M for the Management Reserve. The remaining resources are allocated to New Projects ($0.51M).

Table F.1 SDSS-II 3-Year Cost Forecast (in $000s)

	Original Budget	Current Forecast*	% Change
Survey Management	1,629	1,635	0.4%
Observing Systems	2,552	2,372	(7%)
Observatory Operations	5,174	5,225	1%
Data Processing	2,390	2,436	2%
Data Distribution	1,451	1,485	2%
ARC Support for Observing Systems	207	150	(28%)
ARC Corporate Support	179	177	(1%)
Operations Sub-total	13,582	13,480	(0.8%)
New Development	1,013	1,115	10%
Sub-total	14,595	14,595	0%
Management Reserve	305	1,165	451%
New Projects	0	510	----
Total Cost Forecast	14,900	16,270	9%
Cash Portion	*13,212*	*14,155*	
In-kind Portion	*1,688*	*2,115*	

** as of 31-Oct-2005*

Each year the need to hold resources in the contingency will decrease, and unspent cash in the Management Reserve account from the previous year can be re-allocated to the New Projects account. That is, as long as there are no calls on the Management Reserve, the actual resources expected to be available to the New Projects will exceed $0.51M. Table F.2 shows a set of New Projects with their projected funding profiles that totals $0.93M, as an example. In practice, additional New Projects may be identified and other changes to this scheme may be made. As of this writing, only the CY2006 budget for New Projects has been approved.

Table F.2. Cost Forecast for the New Projects (in $000s)

New Projects	2006	2007	2008	Total
Education and Public Outreach	82	85	47	215
Additional Software Development	38	40	23	100
Data Distribution Operations	60	62	48	170
Add'l Scientific and Engineering Support	80	83	42	205
Support for Collaboration Activities	40	42	33	115
Observer Retention Plan	0	0	125	125
Total	300	312	318	930